



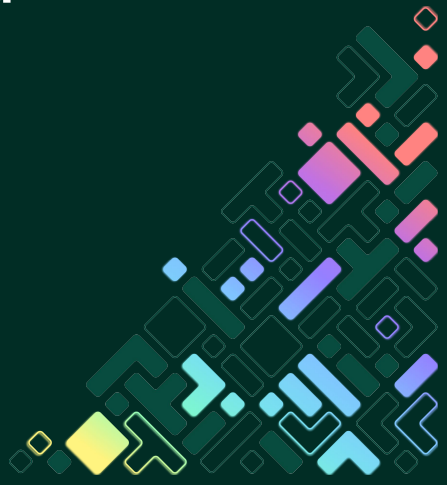
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Modernizing the Development of AI IoT Devices with WebAssembly-based Virtualization

Seattle
16 April 2024



#EmbeddedOSSummit



Vision

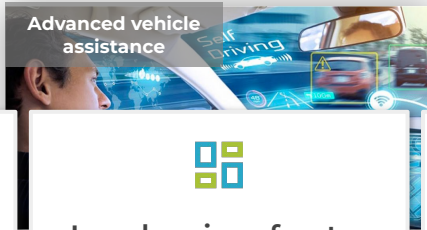
Targeting solution developers for various vertical applications.



Smart Home



Bring to market
easy-to-use sensing
devices



Advanced vehicle
assistance



Low barrier of entry
for solution
developers



Retail stores



Agile development of
sensing applications



Smart Cities



Low operational cost
of vision sensing apps



Polyglot Development

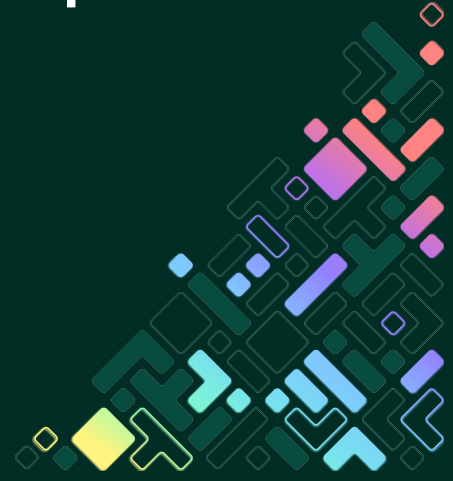


Marketplace to
connect
AI Developers &
Solution Developers



Smart
Manufacturing

Challenges of Embedded Development



Pain Points

Development Process

- Embedded development is difficult - mostly C
- Difficult or impossible to change functionality after deployment
- No standard component model, so customization cost is high
- No isolation => rigid QA process

Portability

- Not platform specific (Can use on ARM, RISC-V, x86, Xtensa, etc)

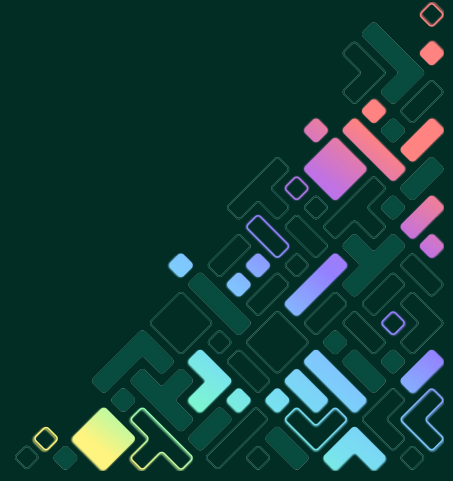
Safety & Security

- Memory Isolation on MCU is difficult or impossible (no MMU)
- RTOS not designed for multi-user thus syscalls are not secured well
- Vulnerabilities cannot all be found before shipping

#1 Source of Security Vulnerabilities is Memory Bugs



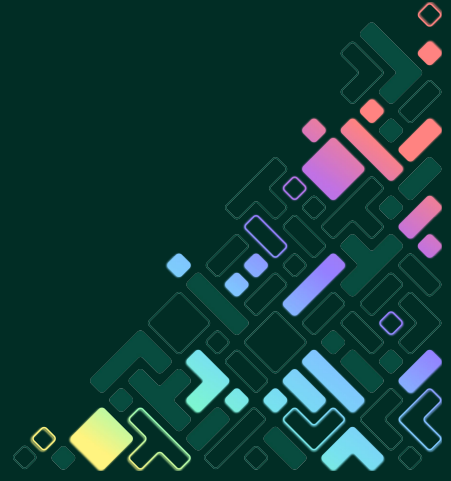
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Why Polyglot Development (especially for AI)

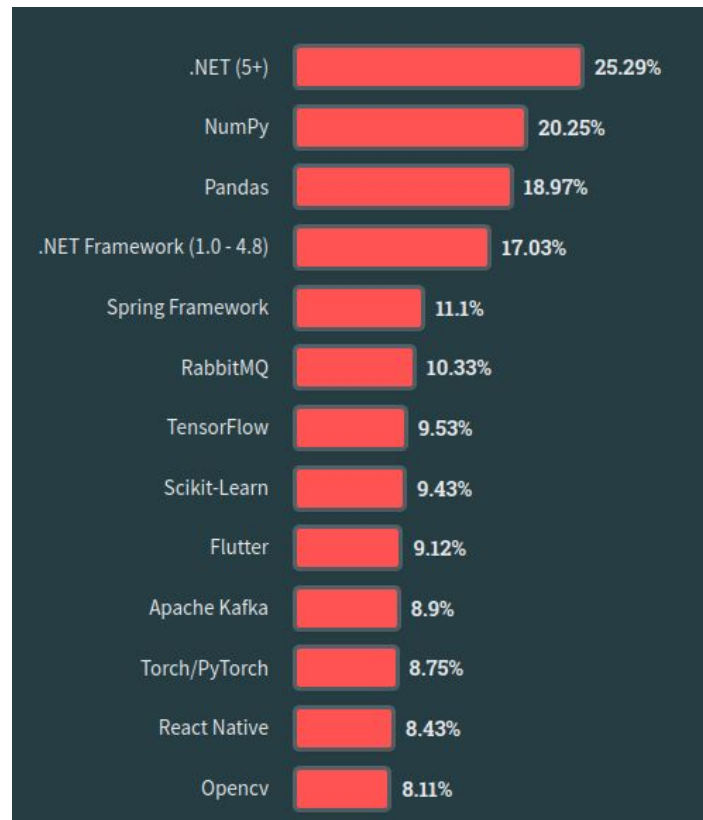
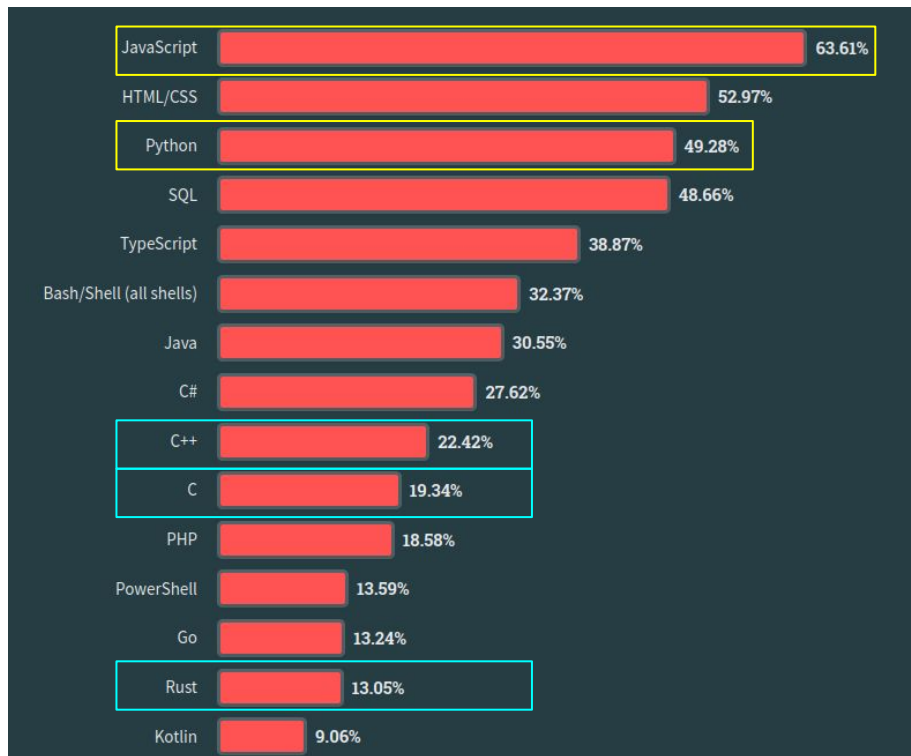


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Most popular programming, scripting, and markup languages

Data extracted from <https://survey.stackoverflow.co/2023>



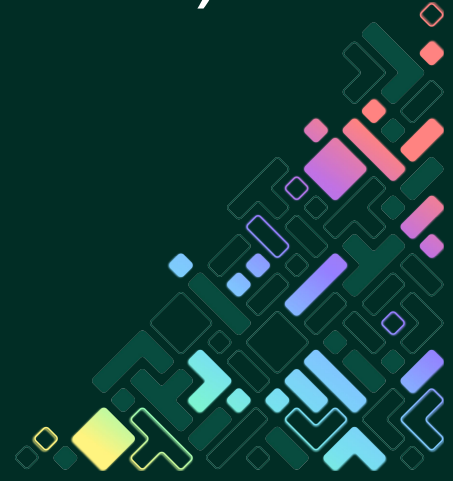
Goals

- Ensure safety while enabling dynamic loading on MMU-less devices
- Reduce the development effort
 - Enable developers of all kinds (e.g. Python) to code for IoT
- Component reuse
- Enable more flexible QA process
- Portability across HW platforms
- Enable marketplace model by application standardization
 - Safe & secure 3rd party apps

EVP (Edge Virtualization Platform)



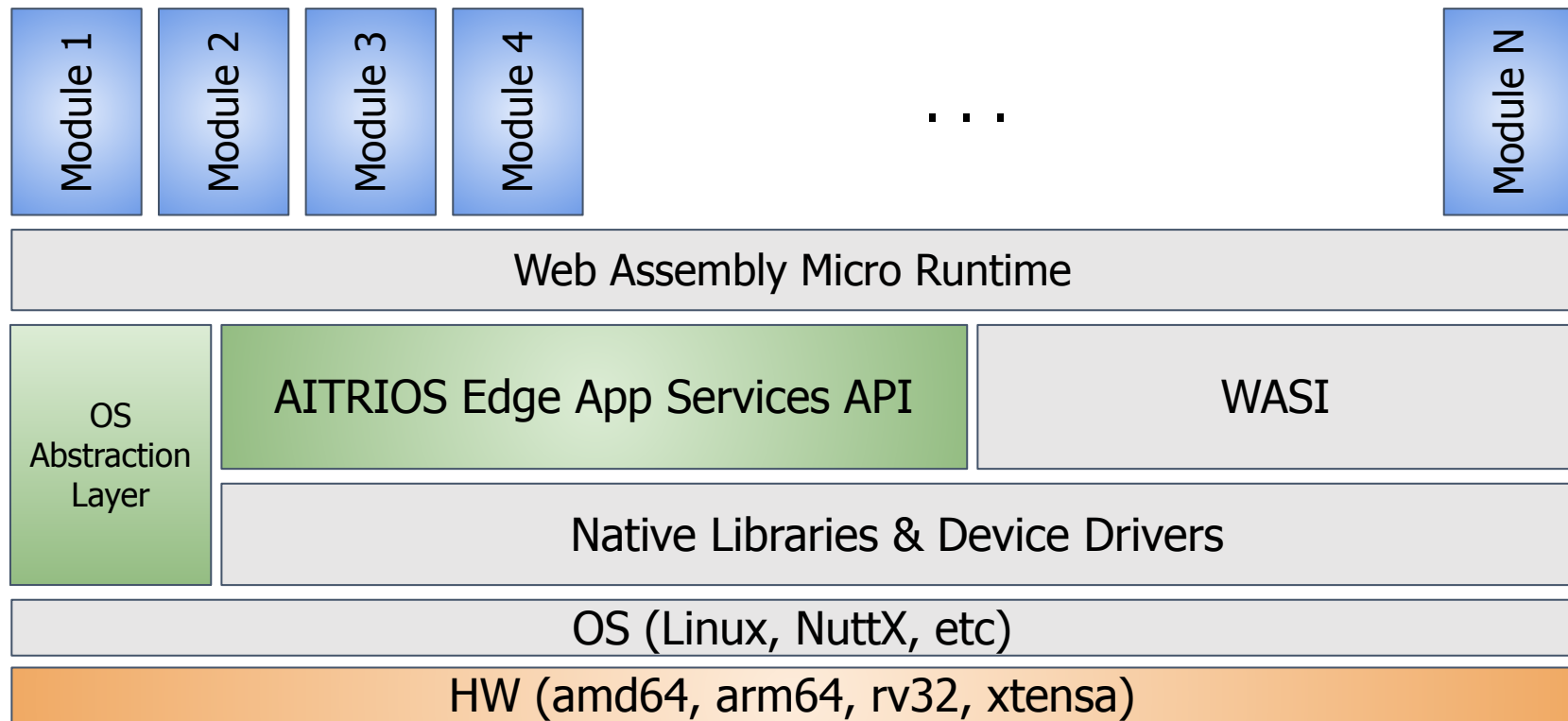
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EVP

- Like Kubernetes, but for Tiny IoT Devices
 - Lifecycle Management of workloads on IoT devices
- EVP Agent is like Kubelet
 - Leverages WebAssembly Micro Runtime (WAMR)
 - Strong isolation of modules
 - Secure even on RTOS
- Communicates with EVP backend via MQTT

EVP Device Stack



Edge App SDK: APIs

WASI-Sensor

- Read Image
- Configure (e.g., frame rate)

WASI-NN

- Load model
- Run inference

Communication

- Telemetry to EVP backend
 - via MQTT
- Device to device
 - Sockets/ZMQ/NNG

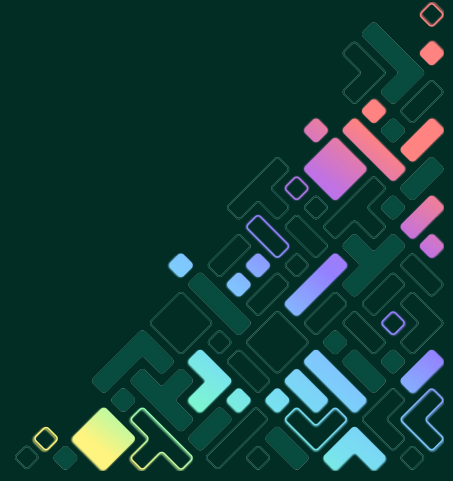
Data Storage

- Local DB
- Blob storage (HTTP PUT/GET/POST)

AITRIOS Edge App Dev Tools



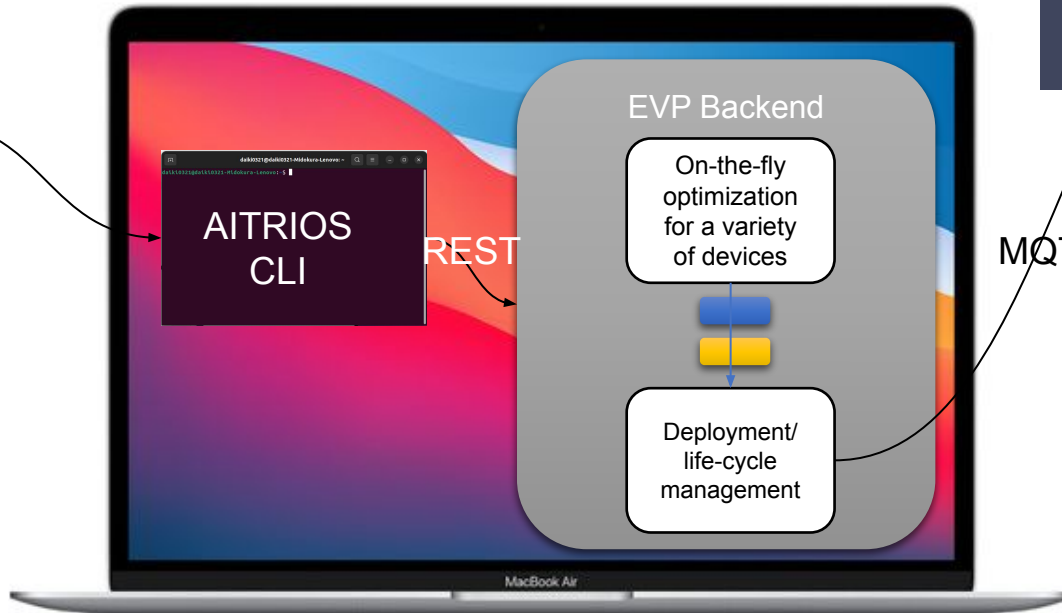
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Local Developer Setup

The developer wants an easy setup to:

1. **Create** project in Host PC.
2. **Build** the application in Host PC.
3. **Deploy** the application to the device



LUCID Vision Labs™
SENSEiZ

MQTT/HTTP

filter nodes

Flow 1

lpd / lpr

sensing pipeline

edit properties

inputs: 0 1

outputs: - 2 +

status node

delete subflow

sensing node

Source

Sink

send_image

inference

license_plate_reading

telemetry_data

extract

ppl_detection_ssd

opencv

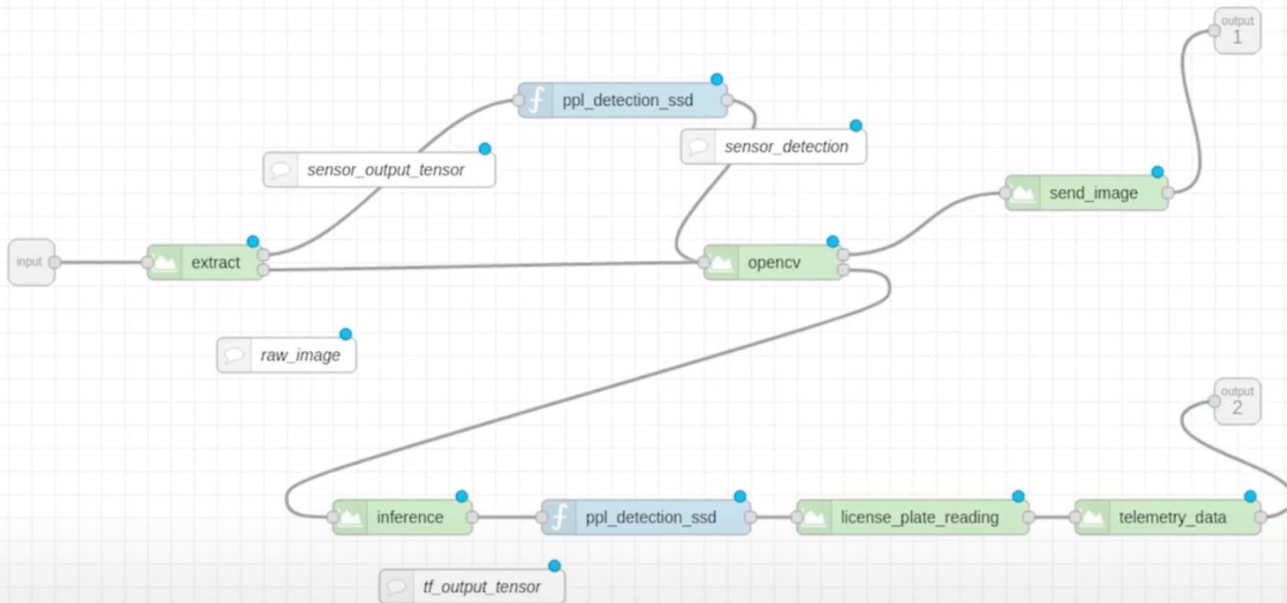
deployment

inject vsa

device

subflows

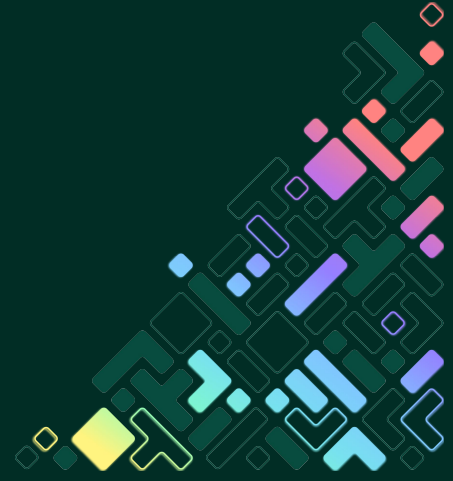
lpd / lpr



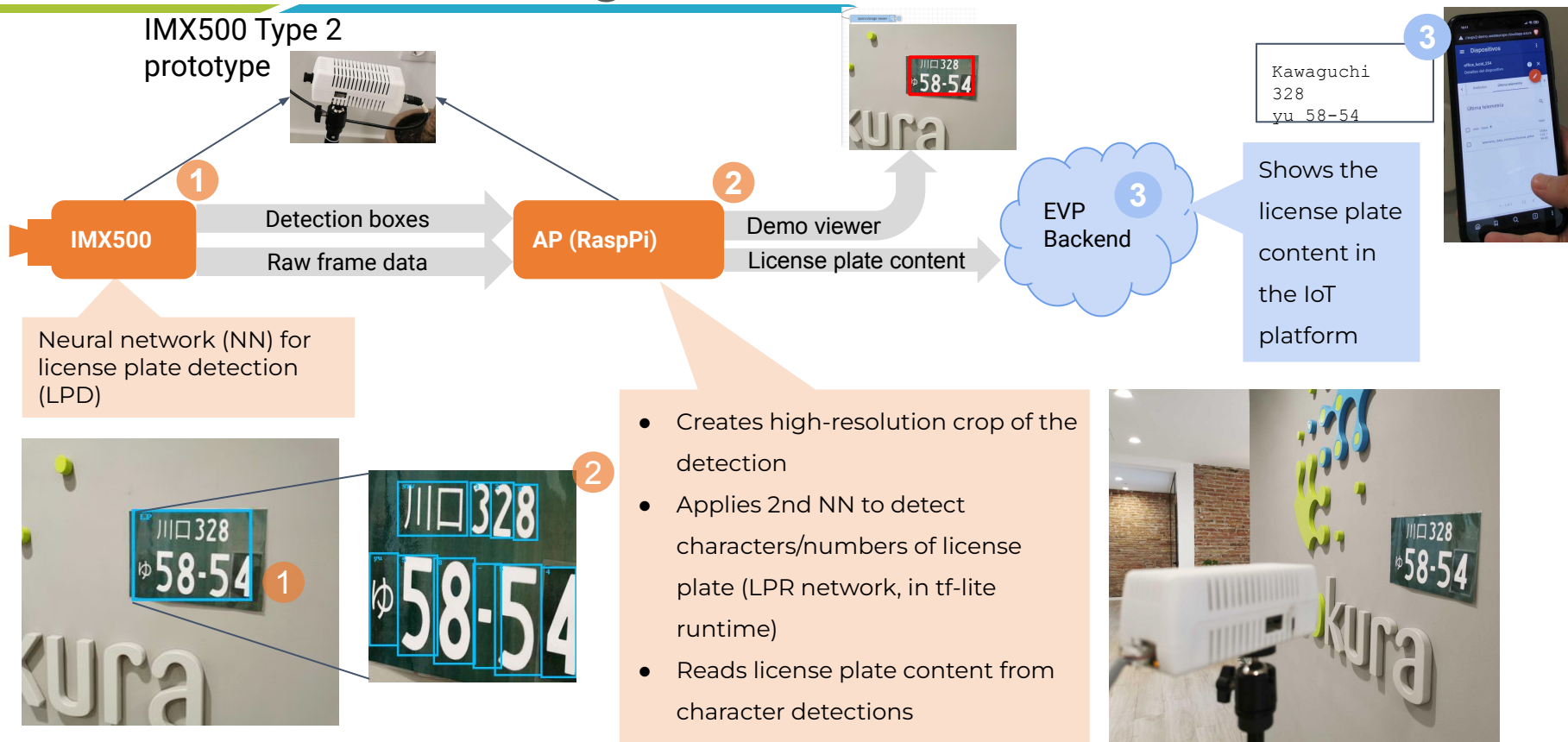
Edge App Example



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License Plate Reading



Node-RED

Deploy

filter nodes

Flow 1

common

inject

debug

complete

catch

status

link in

link call

link out

comment

function

function

switch

change

range

template

delay


trigger

exec

filter

network

opencvimage viewer



Devices

MyDevice

Device details

Details

Attributes

Latest telemetry

Alarms

Events

Relations

Audit Logs

Latest telemetry

Last update time

Key ↑

Value

2022-11-29 18:19:05

telemetry_data_instance/license_plate

Sakai 979, tsu 33-21

Sakai 979, tsu 33-21



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